Implementing an integrated computerized patient record system: Towards an evidence-based information system implementation practice in healthcare

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Abstract

A large number of health information system (HIS) implementations fail due to insufficient organizational harmonization. The aim of this study is to examine whether these problems remain when implementing technically integrated and more advanced generations of HIS. In a case study, data from observations, interviews, and organizational documents were analyzed using qualitative methods. We found that critical issues in the case study implementation process were the techniques employed to teach the staff to use the integrated system, involvement of the users in the implementation process, and the efficiency of the human computer interface. Comparisons with a literature review showed both recurrence of previously reported implementation problems and new issues specific to the integrated system context. The results indicate that the development of evidence-based implementation processes should be considered.

Introduction

Computer-based patient record (CPR) systems form the infrastructure for the timely and accurate collection and exchange of data, information, and knowledge in healthcare organizations, and thus a more efficient use of scarce resources. The productivity of these CPR systems is expected to rise with their increased level of implementation in all healthcare domains, particularly, when primary healthcare (PHC) and home healthcare are included in the infrastructure[1,2].

Healthcare providers are therefore expected to face fiscal and market pressures to implement integrated CPRs (ICPRs). However, in the US, the failure rate for new health information system implementation in healthcare organizations has been estimated to about 50%[3]. The reasons for these failures have been extensively studied and described. For instance, one factor that has been indicated as crucial for success is the involvement of clinicians and other staff in the system development and, specifically, in the human-computer interface design[4]. The need for sufficient technical support and maintenance services has also been highlighted; both during and after initial implementation, and the importance of collaboration between representatives from the system providers and the healthcare site implementing the system has been emphasized[5]. However, despite this knowledge, information system implementation in healthcare settings continues to fail[6,7,8].

In light of the numerous reports of previous failures, it is hard to comprehend why the frequency of the failures persists. The situation is particularly alarming in regard to the introduction of the new generation of complex ICPRs that require major investment. In Sweden (population 9 million), the introduction of such integrated systems has recently been initiated, re-modeling the entire infrastructure for patient-related data management and interconnecting previously isolated systems[9]. Following this, the county councils (n=21) and municipalities (n=290) that manage the provision of healthcare services to citizens are in the process of implementing ICPRs that will allow PHC centers, hospitals, pharmacies, and retirement homes for the elderly to be integrated, allowing the exchange of data and information.

Using data from such an implementation process in a Swedish county, the aim of this study is to analyze whether the previously reported evidence of implementation failures is also valid in the ICPR setting or if these systems create other implementation challenges. The analyses are based on a case study design and use qualitative methods for data collection and analyses.

Case study setting

In the case study county council, CPR systems had, at the time of the study, been used in PHC and at

hospitals for more than 10 years. The county council had also supplied other types of computer systems to the healthcare providers, such as appointment systems, physician-secretary communication systems (for dictation), laboratory systems, x-ray systems, and an e-prescribing system. However, these systems had not been connected to one another to allow the sharing of information and other functions. The new ICPR, developed commercially, provides a comprehensive overview of the patient's health conditions and care. The system provides an infrastructure for sharing patient data and information between all healthcare care providers within the county council.

The system consists of three parts: (A) *drug information*, which consists of overall information about all the patients' medications and prescription-support functions, and is used to send electronic prescriptions; (B) *care documentation*, which consists of all patient notes from physicians, nurses and physiotherapists; and (C) *care administration*, which consists of all administrative information about the patient, such as referral handling, booking times and registration. Table 1 shows the main differences between the systems.

Table 1: Main differences between the stand-alone CPR systems and the integrated CPR system

	Stand-alone system functions	**ICPR functions**
Sharing data	No data sharing between healthcare units. Data shared on paper.	Full data sharing by the system (electronically) within the county council units.
Prescribing	Computerized physician order entry available only for primary healthcare.	All units have computerized physician order entry.
Patient referral	Paper-based referrals to other units used.	Patients referred to other units using the computer.
Documentation	Documentation partly done on the computer.	Full computerized documentation.
System access	Staff can access the system only from the unit they work on.	Staff can access the system from any unit within the county council.
Integration	All the previous systems were not been integrated with each other and different systems worked separately.	One integrated computer-based patient record system.

Methods

A case study design based on a single case was used for data collection and analysis. According to Yin, a case study is an empirical inquiry that investigates a phenomenon within its real-life context, where the demarcation between the phenomenon and the context cannot be made clearly evident[10]. The data were collected during a period of four months through interviews and document analyses. Approximately 40 interviews were performed. The first author first observed and made notes at six of the interviews performed by the second author. In this step, representatives from all professional categories using the new ICPR were interviewed (one physician, two nurses, one social worker, one administrator, and one pharmacist). Then, the second author also interviewed 34 more staff members. Each interview session lasted about two hours. Examples of topics that the questions addressed included perceived strengths and weaknesses of the ICPR, and attitudes towards the implementation process. The interviews were transcribed on a word processor by the second author. Also, we reviewed all documents published by the county council as well as local magazines and newspapers that mentioned the system.

In the qualitative analysis, we first created categories of concepts found in the interview data. These concepts were thereafter aggregated into clusters and associated to form a preliminary small-scale theory. This theory was compared to data obtained from observations and document analyses, and revised to avoid emphasis on issues particular to the healthcare site where the interviews were performed. In the final step of the analysis, the revised small-scale theory was compared to the results of a recent literature review summarizing the present knowledge about HIS implementation processes[2].

Results

In the first-order analysis, it was found that a failure to give all groups of users' adequate training in using the ICPR negatively impacted the outcome of the implementation process. For instance, because the nurses had not learned to use the system functions properly, they found that the new practice routine was time consuming.

Furthermore, there was a general unwillingness to adapt clinical routines to the new system. The main adjustment of the implementation process that the users – especially physicians – asked for was "more involvement in the decision procedures".

Figure 1: Display of the first-order analysis results.

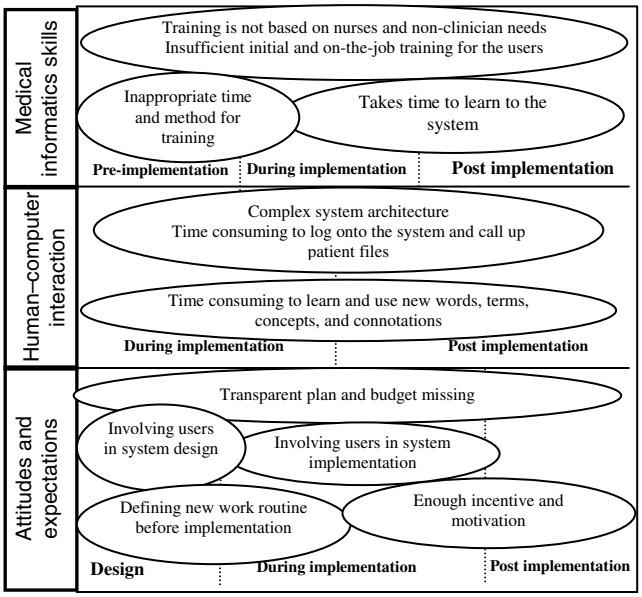

Figure 1 shows an overview of the results from the first-order data analysis. These results were categorized into three sections: medical informatics skills, human–computer interaction, and attitudes and expectations.

Medical informatics skills: The data showed that physicians, nurses, assistant nurses, and front-office staff received only classroom training before they started their routine work in the ICPR. This pedagogical approach was a source of complaint, because the clinicians found that they did not have enough time to practice before "having to swim in the deep [system] end". The nurses and other non-physician staff were particularly unsatisfied, because they felt that the training sessions were based mostly on physicians' needs. One of the interviewees gave voice to the common opinion among the staff that:

"The learning materials are hard to understand and tailored to the needs of all specific professional groups, and the practice as a whole".

Once the system was implemented, ongoing support was reported to be crucial for the success of the newly implemented system. Although the users were mostly satisfied by the availability of a 'super-user' at the site who had received specific training, they asked for the option of further training in order to overcome day-to-day problems.

Human–computer interaction: According to the data, several technical shortcomings remained after the implementation of the ICPRs. The first technical problem was that logging on to the integrated system was perceived as consuming too much time. Then, after logging on to the system, several functions were found to be unintuitive and not user-friendly, causing dissatisfaction and disappointment. One new feature of the integrated system was the ability to call up a 'total' patient record. With the new system, calling up a specific file consumed more time than the previous system. The integrated system also required use of new terms and concepts, and the users emphasized that learning these took time.

Attitudes and expectation: In the case study setting, the users expressed that more user participation in the design and implementation phase of the system would have provided a better fit into workflows and work practices. From their point of view, more user involvement would both have helped define the system requirements in more detail and revise work practices to better integrate the new system. The value that the ICPRs could provide was another consideration that the respondents wished had been discussed prior to the implementation. In other words, the question "what's in it for us?" should have been answered with respect to the individual practitioners using the system. The respondents also made complaints about the timing of the implementation at the pilot site. They felt that the policy-makers had decided to implement the system in too short a time period, causing problems with adjustments, mainly in learning terms and navigation routines. Another concern among the practitioners was whether the general implementation plan was realistic, i.e. included adequate labor and financial resources. Because of the high costs associated with ICPRs, some of the practitioners asked for access to a long-term financial plan in order to get an understanding of the total costs.

Novel challenges versus re-experience of known implementation problems

The comparison of the first-order analysis of the ICPR implementation to the literature review of HIS implementation evaluations displayed both similarities and discrepancies.

Novel challenges in ICPR implementations:

Possibly, the most important challenge in the case study setting concerned the way in which the ICPR implementation process could be adapted to the needs of different user groups. ICPRs will be used by all professional categories and accessed from all sites in

a distributed healthcare organization. Different categories of staff in distributed healthcare organizations require different interfaces and modules in order to carry out their clinical tasks. For example, nurses' needs are different from physicians' needs, and the needs of hospital physicians are different from those of general practitioners and all must be considered. To understand how the implementation of a homogenous system can be adapted to a large variety of user needs and expectations seems to be an important step towards facilitating user adoption of ICPRs.

The second novel challenge associated with implementation of ICPRs was the human-computer interaction consequences of the large-scale technical integration of sub systems into a homogenous infrastructure. Even though the ambition was to achieve an effective and user-friendly system, both long response times and co-existence of different interface designs in same user-task operations proved to be contrary to this.

Re-experiences of known implementation problems:

From the literature, it is known that the techniques used for teaching the use of CPRs can easily become a matter of controversy. In the case study setting, as reported from many other contexts, the fact that users' training were based on physicians' needs and not adjusted to nurses and other non-clinicians was a major source of complaints. From the case study setting, requests were expressed for user involvement in the design and implementation phase of the system, in order to provide better insights into existing workflows and work practices. There is an abundance of literature on the benefits associated with involving users in the system design, thereby reducing problems with mismatches between work-routines and the new system, and thus increasing user adoption.

Discussion

The aim of this study was to analyze whether the previously reported reasons for implementation failure were still valid in the ICPR setting, or if the latter systems created novel implementation challenges. The results suggest that several well-known problems are valid in the ICPR context, while these complex systems also are associated with additional challenges. One of the most important factors that influenced the case study implementation process was the design of the user-training program. Our finding that nurses and other non-medical staff categories complained because the system implementation was mainly adapted to the needs of physicians is consistent with previous reports[6]. Insufficient user training can also cause secondary problems and misconceptions that may unnecessarily lead the implementation process down more complicated paths, for example, false impressions among clinical staff that the HIS is not appropriately designed may lead to demands for the withdrawal of a functional system[11].

Further, the fact that close coordination of operations between the end-users and the system suppliers is beneficial also seems to be valid for the ICPR setting. Our finding that the end-users in the case study wanted more involvement throughout the planning and preparation stages of the design is consistent with previous studies[12]. The need for sufficient technical support has also been highlighted; both during and after initial implementation and the importance of collaboration between representatives from the CPR provider and the healthcare site implementing the CPR has been emphasized[5]. However, it is important to note that this is a wish that can not always be satisfied, because some end-users reject the possibility to participate due to time constraints for example, practitioners. In conclusion it is usually not realistic to achieve the full participation of all team members.

In ICPR deployment, implementation leaders have to be prepared to make changes 'on the fly' in response to issues reported by the different user groups, for instance, to put more emphasis on technical or organizational issues, depending of the needs of the end-users. However, methods and training programs that prepare system suppliers for addressing and combining the opinions of all professional categories involved in an ICPR implementation process are scarce. It is therefore necessary to develop new work methodologies to prepare system suppliers to constantly revise implementation strategies, considering both user needs and new scientific evidence.

Moreover, the ICPR was aimed at integrating previously separate systems and allowing the exchange of patient data and information. However, the users stated that this integration was not fully achieved at the time of the system implementation. The way to solve the remaining technical issues in ICPR development, therefore, not only involves ensuring compatibility between system components and terminologies, but also ensuring that system response times can be kept within tolerable limits[9].

The study has several limitations that must be considered when interpreting the results. First, the

data were collected when the ICPR was in a pilot phase and was not yet realized in its full extent, and the results mainly reflect the experiences of novice users who are still learning how to use the system. If the data collection had been performed later in the implementation process, some of the 'first impressions' of the ICPR may have disappeared and more positive experiences from interaction with other healthcare units have been gained. However, the aim of this study was to analyze whether the previously reported evidence about implementation failures is also valid in the ICPR setting or if these systems create other implementation challenges and not to analyze the change that has occurred over time. Such changes can be a consequence of improvements of training programs, the inclusion of homogenous users or possible changes that the system suppliers have done to improve the system. Another limitation is that only qualitative analyses were performed, restricting the possibility of applying the results to other settings. Comparative quantitative studies of ICPR implementation processes involving multiple sites are therefore warranted.

Based on the results, we suggest following propositions for further research and development. ICPRs are introduced to fulfill a high number of organizational, individual-based and socio-technical goals at different levels. It is therefore necessary to link the goals that the system is to fulfil in relation to the short-term, middle-term and long-term strategic goals as well as with prevalent Business Process Re-engineering aims of the clinical organizations and its staff. The second suggestion is that implementers and vendors have to direct more attention to what has been published in the area to avoid more future failures[13]. The third proposition is based on the assertion that "if we want more evidence-based practice, we need more practice-based evidence"[14]. We suggest using simulations models that allow to clearly identifying effects and consequences of decisions stimulating a learning process that is beneficial for the organizations as well as individuals. The development and application of such procedures in tandem with continued research would, over time, strongly benefit the creation of more efficient ICPR implementation processes and lower system failure rates.

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